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## PATENT SPECIFICATION



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238,303

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### COMPLETE SPECIFICATION.

#### A Method of, and Apparatus for, Treating Liquids with Gases.

I, THEODOR STEEN, a German national, of Knesebeckstrasse 77, Berlin, Charlottenburg, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

A usual method of chemically treating liquids by absorption of gases in the presence of a catalyzer consists in stirring up the finely divided catalyzer with the liquid, and introducing the gas. This method has some defects, largely due to bad distribution of the catalyzer. Another method consists in making the liquid and the catalyzer circulate, and passing the gas into a portion of the circuit, in the opposite direction to the flow of liquid, the liquid being generally pumped out of an autoclave, with the catalyzer, and sprayed into another autoclave, into which the gas is introduced at the bottom. The gas not absorbed is sucked out at the top of the second autoclave, and re-compressed. This is a considerably more efficient method, but is somewhat slow; for example, for hydrogenating oils and fats, from 15 to 17 hours, may be required.

According to this my invention the body of liquid containing the catalyzer is maintained in circulation by introducing therein a stream of the gas which propels it along a defined path, in a closed circuit, and in the course of its circulation the liquid is sprayed or sprinkled in thin streams through an atmosphere formed by another part of the gas, which has been injected into the body of liquid and has traversed the same in the opposite direction to that in which the traversed liquid is flowing. This greatly increases the efficiency of the process, and the period of 15 to 17 hours hereinbefore referred to may be reduced to  $3\frac{1}{2}$  or 4 hours. This is probably due, or in part due, to the fact that with the former

method the pumping of the liquid deprived the catalyser of some of its activity while out of contact with the gas, and this activity was only gradually recovered in contact with the gas; so that during part of the spraying operation the catalyzer was more or less idle. In my present invention the catalyzer and the gas are kept in constant contact, and the reaction may proceed throughout the circuit, instead of only in a comparatively small portion thereof. It has been proposed heretofore, for the treatment of gas with a liquid and dissolved catalyzer, to inject one stream of gas into the body of liquid and produce a spray which trickles back into the liquid, another stream of the gas being introduced over the surface of the liquid, to pass through the spray. An apparatus has been used, in which a tube with a cyclonic distributor at the top depends into the liquid, one stream of gas being injected into the lower end of this tube, and the other stream of gas being injected above the liquid level into the spray falling to the liquid level from the distributor. In my invention both streams of gas are, as stated, introduced into the body of the liquid so that a more continuous and intimate contact between the liquid and gas is obtained.

An example of apparatus for my improved process is shown in section in the annexed drawing.

The cylindrical autoclave or container 1, closed at the top is tapered at 2, so that precipitated particles gravitate towards the lower orifice of a vertical tube 4 within the container. The upper orifice 5 of this tube is within a receptacle 6, whose floor is perforated, so that liquid introduced into the receptacle flows out in the form of a fine rain as shown at 7. The mouth of the tube 4 is somewhat above the perforated floor. Around the lower portion of the tube 4 there is a tubular ring having holes in its upper

part and connected by a pipe 9 to one side of a compressor 10. The other side of the compressor 10 has joined thereto a pipe 11 leading into the container 1 and terminating within the orifice 3 of the tube 4. Both sides of the compressor are connected to the container 1, above the liquid level, by a pipe 12 having two branches with suction valves at the ends thereof joined to the compressor.

The liquid, mixed with the catalyzer, is placed in the container 1, and the compressor 10 delivers the gas in part to the tube orifice 3 and in part to the ring 8. The gas entering the tube 4 drives the liquid therein upwards into the container 6, whence it descends in thin streams through the perforations at the bottom. Consequently there is produced an energetic circulation of the liquid as indicated by arrows in the drawing, part of the gas flowing with the liquid up the tube 4 and part flowing from the perforated ring 8 in the opposite direction thereto. The catalyzer is mixed very intimately with the liquid and gas, and the action tends further to subdivide it, so as to increase the contact surface. The unabsorbed gas above the liquid level is sucked by the compressor through the pipe 12, and is re-delivered to the container 1, through the pipes 9 and 11 alternately. Fresh gas may be supplied to the compressor or to the container 1. The process may be performed with gradually increasing pressure, the fresh gas being supplied at a rate exceeding that at which the liquid can absorb gas.

The process and apparatus described may be used with advantage for many purposes in the chemical and allied industries, where a liquid is to be treated with a gas in the presence of a catalyzer; an example is the treatment of liquid hydrocarbons with hydrogen in the presence of a catalyzer.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The process of treating a mixture of liquid and catalyst with gas, which consists in passing the gas into the liquid mixture through two inlets, the gas issuing from one inlet imparting circulation to the mixture, and the gas issuing from the other inlet traversing the mixture in a direction contrary to that of its circulation, the mixture being maintained in contact with gas throughout its course.

2. Apparatus for the process claimed in Claim 1, comprising an autoclave having therein a tube open at top and bottom, a gas-inlet tube for introducing the gas under pressure into the lower part of said open-bottomed tube, for forcing the liquid upwards therethrough, a second gas-inlet tube for introducing gas below the liquid level outside said open-bottomed tube, and a liquid distributor at the upper end of said open-bottomed tube, whereby the raised liquid is caused to descend in thin streams outside the tube.

3. Apparatus as claimed in Claim 2, wherein the device at the upper end of the tube is a receptacle having a perforated bottom through which the tube extends, so that the mouth of the tube is somewhat above said bottom.

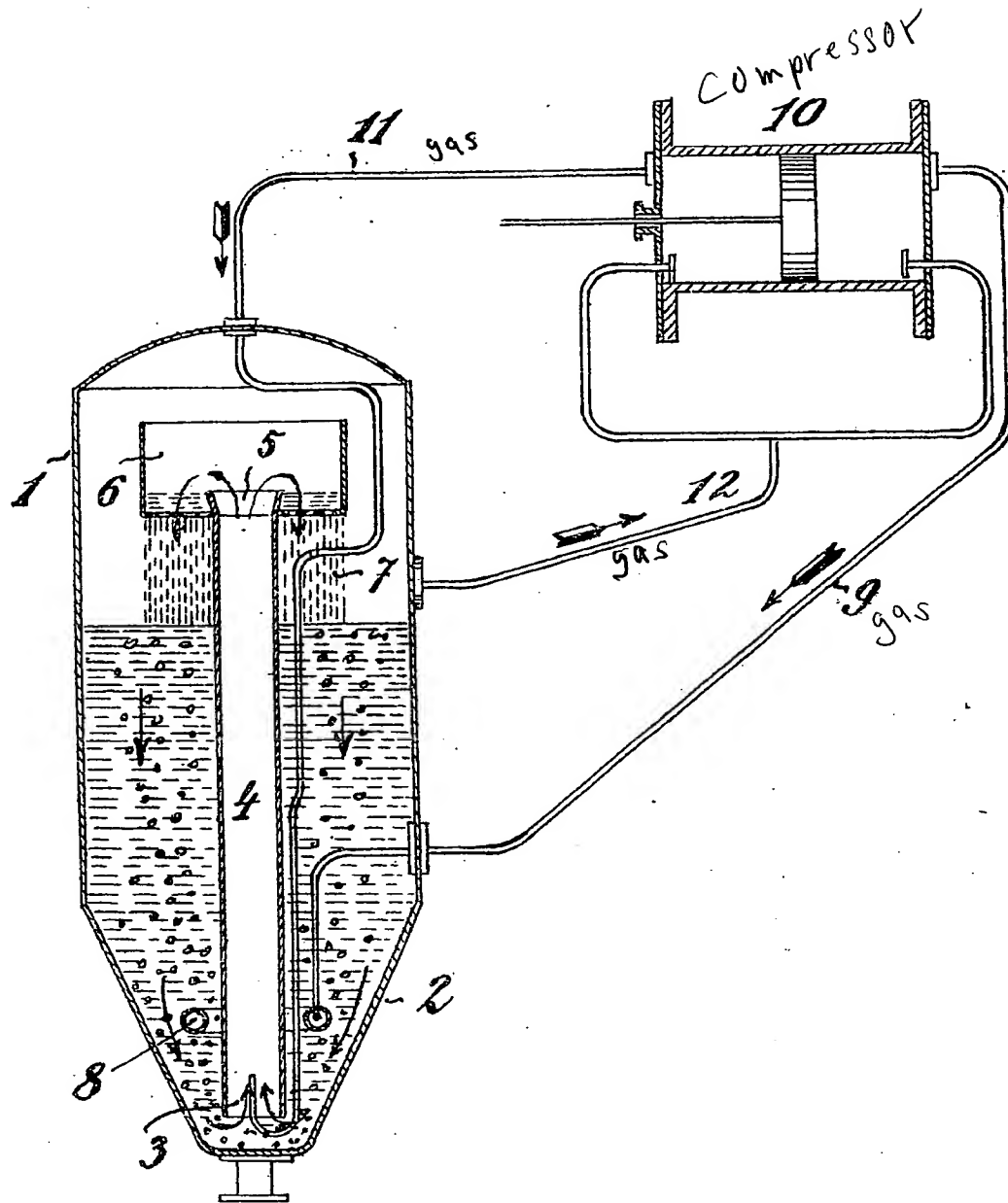
4. Apparatus as claimed in Claim 3 with a compressor arranged to deliver the gas to the two inlet tubes alternately.

Dated this 16th day of May, 1924.

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[This Drawing is a reproduction of the Original on a reduced scale.]



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